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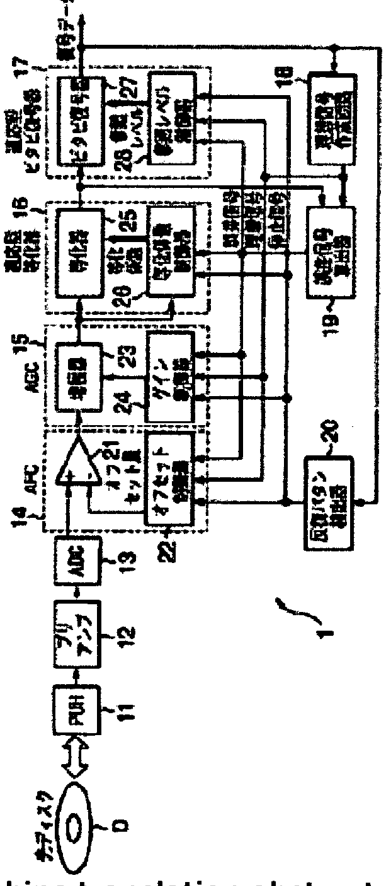
Abstract:
PROBLEM TO BE SOLVED: To provide a stable operation for an optical disk device which conducts PRML (Partial Response and Maximum Likelihood) processing by holding an equalization process and a viterbi decoding process when the repeating data to the sections such as a VFO (Variable Frequency Oscillator) section or the like are detected.SOLUTION: The optical disk device is provided with an equalizer 16 which equalizes reproduced signals from an optical pickup 11 on the basis of given error signals, a viterbi decoder 17 which conducts a viterbi decoding of the reproduced signals, an ideal signal generating circuit 18 which generates ideal signals in accordance with the decoded reproduced signals, an error signal computer 19 which computes error signals from the data string of the reproduced signals and the data string of the ideal signals and outputs the error signals to the equalizer, and a repeating pattern detector 20 which supplies stopping signals to the equalizer and the viterbi decoder or the like to hold the processes when a repeated pattern is detected in the reproduced signals from the decoder 17. Stable operations are realized by holding the processes in the repeated data of the sections such as the VFO section or the like.



JPO Machine translation abstract:
(57) **Abstract**

SUBJECT In the optical disk unit accompanied by PRML processing, if the repetitive data of the VFO section etc. is detected, equalization processing and the Viterbi decoding processing will be held and stability of operation will be planned.
Means for Solution The equalizer 16 which equalizes a regenerative signal from the optical pickup 11 based on an error signal given, The Viterbi decoder 17 which carries out the Viterbi decoding of this regenerative signal, and the ideal signal creation circuit 18 which creates an ideal signal according to a decrypted regenerative signal, The error signal calculation machine 19 which computes an error signal from a data row of a regenerative signal, and a data row of an ideal signal, and is outputted to an equalizer, It is an optical disk unit which has the repetitive pattern detector 20 which supplies a stop signal to an equalizer, the Viterbi decoder, etc., and makes processing hold when a repetitive pattern is detected in a regenerative signal from the Viterbi decoder 17, Stability of operation can be planned by making processing hold in repetitive data of the VFO section etc.

Claim(s)
Claim 1 In an optical disk unit treating an optical disc which has concentric circle shape or a spiral storage area, A regenerative-signal detection means to detect a regenerative signal which irradiates with a laser beam on an optical disc which rotates with a prescribed rotational frequency, and contains a data row of specified time width according to a waveform pattern of this reflected wave, A regenerative-signal equalization means which equalizes said regenerative signal which determined an equalization modulus based on an error signal given, and a regenerative-signal detection means outputted according to this, A maximum-likelihood-decoding means to decrypt a regenerative signal in which equalization was carried out by said regenerative-signal equalization means with a maximum-likelihood-decoding machine, and to output a regenerative signal, An ideal signal making means which creates an ideal signal corresponding to a data row of specified time width which a regenerative signal which said maximum-likelihood-decoding means outputs has containing a data row in said specified time width, A data row of said specified time width which a regenerative signal outputted from said regenerative-signal equalization means contains, A data row of said specified time width which an ideal signal which said ideal signal making means created contains is compared, When a regenerative signal which an error signal calculating means which computes an error signal based on this comparison result, and is supplied to said regenerative-signal equalization means, and said maximum-likelihood-decoding means output is received and a repetitive pattern is detected in this, generate a stop signal and this Said regenerative-signal equalization means and said maximum-likelihood-decoding means, A processing means to receive a regenerative signal from said regenerative-signal detection means, to perform prescribed processing, and to supply said regenerative-signal equalization means, An optical disk unit possessing a repetitive pattern detection means to make processing which a means by which supplied at least one of the **, and said stop signal was supplied by this performs hold.
Claim 2 An offset control means which said processing means calculates the amount of gaps from ideal value of a center level about a regenerative signal in which equalization was carried out by said regenerative-signal equalization means, and subtracts this from a regenerative signal, It has a gain control means which makes an amplification factor of an amplifier of a regenerative signal change, and makes change of amplitude a fixed range about a regenerative signal in which equalization was carried out by said regenerative-signal equalization means.
When a repetitive pattern is detected in a regenerative signal, said repetitive pattern detection means generates a stop signal, and supplies this to all of said offset control means, said gain control means, said regenerative-signal equalization means, and said maximum-likelihood-decoding means, The optical disk unit according to claim 1 making each of each processing hold.

Claim 3 The optical disk unit according to claim 1 generating a stop signal if said repetitive pattern detector receives a regenerative signal which said maximum-likelihood-decoding means outputs and a repetitive pattern is detected in this, supplying this only to said regenerative-signal equalization means, and making processing of said regenerative-signal equalization means hold.
Claim 4 Said repetitive pattern detector receives a regenerative signal which said maximum-

likelihood-decoding means outputs, The optical disk unit according to claim 1 generating a stop signal if a repetitive pattern is detected in this, supplying this to said regenerative-signal equalization means and said error signal calculating means, and making processing of said regenerative-signal equalization means, and processing of said error signal calculating means hold.

Claim 5 An offset control means which said processing means calculates the amount of gaps from ideal value of a center level about a regenerative signal in which equalization was carried out by said regenerative-signal equalization means, and subtracts this from a regenerative signal, It has a gain control means (15) which makes an amplification factor of an amplifier of a regenerative signal change, and makes change of amplitude a fixed range about a regenerative signal in which equalization was carried out by said regenerative-signal equalization means.
The optical disk unit according to claim 1 said repetitive pattern detection means' generating a stop signal, and supplying this to said offset control means and said gain control means when a repetitive pattern is detected in a regenerative signal, and making each of each processing hold.

Claim 6 An offset control means which said processing means calculates the amount of gaps from ideal value of a center level about a regenerative signal in which equalization was carried out by said regenerative-signal equalization means, and subtracts this from a regenerative signal, It has a gain control means which makes an amplification factor of an amplifier of a regenerative signal change, and makes change of amplitude a fixed range about a regenerative signal in which equalization was carried out by said regenerative-signal equalization means.
The optical disk unit according to claim 1 said repetitive pattern detection means' generating a stop signal, and supplying this to said offset control means, said gain control means, and said regenerative-signal equalization means when a repetitive pattern is detected in a regenerative signal, and making each of each processing hold.

Claim 7 An analog offset control means which calculates the amount of gaps from ideal value of a center level by analog processing, and subtracts this from a regenerative signal about said regenerative signal as an analog signal outputted from said regenerative-signal detection means, About a regenerative signal as an analog signal which it shifted **analog signal** with said analog offset controllers, and had quantity subtracted, An analog gain control means to output a regenerative signal which made an amplification factor of an amplifier of a regenerative signal change by analog processing, and made change of amplitude a fixed range, The optical disk unit according to claim 1 receiving a regenerative signal as an analog signal from said analog gain control means, changing into a digital signal, and having further said AD converter means which carries out regenerative-signal equalization means supply.
Claim 8 In an optical disk unit treating an optical disc which has concentric circle shape or a spiral storage area, A regenerative-signal detection means to detect a regenerative signal which irradiates with a laser beam on an optical disc which rotates with a prescribed rotational frequency, and contains a data row of specified time width according to a waveform pattern of this reflected wave, An AD translation means which receives a regenerative signal from said regenerative-signal detection means, and carries out the AD translation of this to a digital regenerative signal which is a digital signal, About a digital regenerative signal changed by said AD translation means corresponding to an error signal given, Offset processing which calculates the amount of gaps from ideal value of a center level, and subtracts this from a digital regenerative signal, A digital processing means to perform at least one side with gain control processing which makes an amplification factor of an amplifier of this change and makes change of amplitude a fixed range about said digital regenerative signal, A regenerative-signal equalization means which equalizes said digital regenerative signal which said digital processing means outputted based on a predetermined equalization modulus, . Corresponded to a data row of specified time width which a digital regenerative signal which a maximum-likelihood-decoding means to decrypt a digital regenerative signal in which equalization was carried out by said regenerative-signal equalization means with a maximum-likelihood-decoding machine, and to output a digital regenerative signal, and said maximum-likelihood-decoding means output has. An ideal signal making means which creates an ideal signal containing a data row in said specified time width, A data row of said specified time width which a regenerative signal outputted from said regenerative-signal

equalization means contains, An optical disk unit possessing an error signal calculating means which compares a data row of said specified time width which an ideal signal which said ideal signal making means created contains, computes an error signal based on this comparison result, and is supplied to said digital processing means at least.
Claim 9 The optical disk unit according to claim 8 which said error signal calculating means supplies said error signal also to said digital processing means aforementioned regenerative-signal equalization means, and is characterized by said regenerative-signal equalization means performing equalization processing of a digital regenerative signal based on this error signal by this.
Claim 10 Said error signal calculating means supplies said error signal to said digital processing means aforementioned regenerative-signal equalization means and said maximum-likelihood-decoding means, The optical disk unit according to claim 8, wherein said regenerative-signal equalization means performs equalization processing of a digital regenerative signal based on this error signal by this and said maximum-likelihood-decoding means performs decoding processing of a digital regenerative signal based on this error signal.
Claim 11 An analog offset control means which calculates the amount of gaps from ideal value of a center level by analog processing, and subtracts this from a regenerative signal about said regenerative signal as an analog signal outputted from said regenerative-signal detection means, It has further at least one side with an analog gain control means to output a regenerative signal which made an amplification factor of an amplifier of a regenerative signal change by analog processing, and made change of amplitude a fixed range, about said regenerative signal as an analog signal, The optical disk unit according to claim 8 to 10 supplying a regenerative signal processed by this to said AD translation means.

Detailed Description of the Invention
0001
Field of the Invention This invention is an optical disk unit and relates to the optical disk unit especially using a PRML system.
0002
Description of the Prior Art These days, the optical disk unit which performs record reproduction processing to optical discs, such as DVD (Digital Versatile Disc), has spread widely, and it is produced commercially by performing development with various systems. For example, as a system of record reproduction processing of an optical disk unit, there is a PRML (Partial Response and Maximum Likelihood) system, and drawing 19 shows the general composition of the optical disk unit which used this system.
0003 In drawing 19, the information recorded on the optical disc is played as a weak analog signal using PUH (pickup head-ick Up Head). After an analog signal is amplified by a preamplifier and set to sufficient signal level, AFC of an analog () **Auto Offset Controller and** AGC of an analog set to automatic offset-controllers and following AFC () **Auto Gain Controller and** an automatic-gain-control machine and following AGC -- carrying out -- offset and a gain are adjusted, then it is changed into a digital signal by an AD converter (Analog to Digital Converter). After equalization of the digitized regenerative signal is carried out so that a predetermined PR characteristic may be approached according to an error signal with an adaptive equalizer, it obtains binary decode data with an adaptive Viterbi decoder.
0004 The composition of the equalization-modulus controller used for an adaptive equalizer is shown in drawing 20. Four unit delay elements by which cascade connection was carried out so that the regenerative signal by which phase adjustment was carried out with the delay device might be delayed, Five multipliers which perform the multiplication of input and output and the error signal of these unit delay elements, It comprises an accumulation machine which carries out accumulation of the output of a multiplier respectively, a multiplier which multiplies the output of an accumulation machine by the control sensitivity alpha (0< alpha<1), an adding machine adding the present equalization modulus set as the output and equalizer of a multiplier, and a memory holding the present equalization modulus.
0005 Thus, the equalizer which controlled the equalization modulus according to change of a

regenerative signal is called an adaptive equalization machine, and it is indicated by Journal of the Institute of Electronics, Information and Communication Engineers Vol.81, No.5, and pp.497-505 (May, 1998) about the adaptive equalization machine, for example.

0006 The composition of the reference level controller used for an adaptive Viterbi decoder is shown in drawing 21. This calculates reference level from an equalization signal and the survival path computed from the pass memory in the Viterbi decoder. The average value of the value which was accumulated in two or more memories which survived the equalization signal and were divided for every level using the path, and was accumulated in the memory for every level is calculated, and let it be reference level.

0007 Next, various PR characteristics are explained using drawing 22. (a) - (d) of drawing 22 shows record data, a recording waveform, a pit sequence, and a regenerative waveform, respectively. The waveform after equalization when an equalizer performs equalization based on PR (1, 1) characteristic, PR (1, 2, 1) characteristic, and PR (1, 2, 2, 1) characteristic is shown in (e) of drawing 22, (f), and (g) to the regenerative waveform of (d) of drawing 22, respectively. PR (1, 1) characteristic means the characteristic of appearing at a rate of 1:1 respectively at two identification points when an impulse response continues. PR (1, 2, 1) characteristic means the characteristic of appearing at a rate of 1:2:1 respectively at three identification points when an impulse response continues. PR (1, 2, 2, 1) characteristic means the characteristic of appearing at a rate of 1:2:2:1 respectively at four identification points when an impulse response continues. The same can be said for the PR characteristic which is others although not illustrated.

0008 It turns out that the waveform after equalization has the characteristic which became blunt in order of the PR (1, 1) characteristic ->PR (1, 2, 1) characteristic ->PR (1, 2, 2, 1) characteristic as shown in (e) of drawing 22, (f), and (g). In a PRML system, the increase in the signal deterioration ingredient in an equalizer can be controlled by carrying out waveform equalization to the PR characteristic near the characteristic of a regenerative waveform.

0009 Generally in the regenerative-signal processor of a PRML system, the Viterbi decoder which is typical one of the maximum-likelihood-decoding machines is used for the detector arranged after an equalizer. Supposing equalization of the regenerative waveform is carried out with an equalizer to PR (1, 2, 2, 1) characteristic, out of all the series with which PR (1, 2, 2, 1) characteristic is filled, an error with the sample sequence of an equalization signal will choose the smallest series, and the Viterbi decoder will output the decode data corresponding to the selected series. In order to carry out from two or more sampled values in a PRML system rather than to decode from one sampled value, the tolerance over the signal deterioration ingredient which does not have correlation between sampled values is strong.

0010 In the optical disc which such an optical disk unit treats. The repetitive pattern called VFO (Variable Frequency Oscillator, a variable frequency oscillator, and the following are referred to as VFO) used for drawing in of a PLL (Phase Lock Loop) circuit other than the data which should be recorded essentially, etc. is recorded. As a pattern of VFO, what is called a 4T repetition pattern of 0000111100001111 -- is used. When storage density is high, as drawing 24 shows, regenerative-signal envelopes differ by the VFO section and a data division.

0011 However, as (a) of drawing 25 shows in this way, when regenerative-signal envelopes differ by the VFO section and a data division, in order to amplify the regenerative-signal envelope of the VFO section to predetermined amplitude in an automatic gain control circuit, The regenerative-signal envelope immediately after a data division start will become larger than predetermined, and as shown in (b) of drawing 25, degradation of identification performance will be caused.

0012 By the VFO section and a data division, when carrying out the adaptive control of the equalization modulus as shown in (c) of drawing 25 since the regenerative-signal characteristics differ, the VFO section will differ in the RMS (Root Mean Square) value of an error signal greatly from a data division. There is a problem that this causes the increase in the convergence time of equalization-modulus control and emission of an equalization modulus, and also the difference of the regenerative-signal characteristic of the VFO section and a data division invites the instability of reference level also to reference level control.

0013 The vertical asymmetry called asymmetry as shown in the graph of drawing 26 is included in a still more nearly actual regenerative signal. In this case, in the conventional automatic gain control circuit, the level **level / which makes identification performance best** shifted is put in order as an offset level.

0014

Problem to be solved by the invention Namely, it is AGC when regenerative-signal envelopes differ by the VFO section and a data division in the conventional optical disk unit, In order to amplify the regenerative-signal envelope of the VFO section to predetermined amplitude, the regenerative-signal envelope immediately after a data division start becomes larger than predetermined, and there is a problem of causing degradation of identification performance.

0015 Since the VFO section differs in the regenerative-signal characteristic from a data division, when the adaptive control of the equalization modulus is carried out, By the VFO section and a data division, the RMS (Root Mean Square) values of an error signal differ greatly, and The increase in the convergence time of equalization-modulus control, Or emission of an equalization modulus is caused and the difference of the regenerative-signal characteristic of the VFO section and a data division has the problem of making reference level unstable also in reference level control.

0016 The vertical asymmetry called asymmetry is included in a still more nearly actual regenerative signal, and there is a problem of putting in order the level **level / which makes identification performance best** shifted as an offset level in it, by the conventional AGC.

0017 In the further conventional optical disk unit, since the offset control by AFC of an analog and the gain control by AGC of an analog are used, it is necessary to carry out the DA translation of the control value by digital one and, and there is a problem that sufficient high-speed control cannot be performed.

0018 This invention is detecting the repetitive pattern of a regenerative signal, identifying the VFO section, and holding each processing, and an object of this invention is to provide the optical disk unit which controls degradation of identification performance and obtains stability of operation.

0019

Means for solving problem An optical disk unit treating the optical disc which has concentric circle shape or a spiral storage area whose this invention is characterized by that an optical disk unit comprises the following.

A regenerative-signal detection means to detect the regenerative signal which irradiates with a laser beam on the optical disc which rotates with a prescribed rotational frequency, and contains the data row of specified time width according to the waveform pattern of this reflected wave.

The regenerative-signal equalization means which equalizes said regenerative signal which determined the equalization modulus based on the error signal given, and the regenerative-signal detection means outputted according to this.

A maximum-likelihood-decoding means to decrypt the regenerative signal in which equalization was carried out by said regenerative-signal equalization means with a maximum-likelihood-decoding machine, and to output a regenerative signal.

The ideal signal making means which creates the ideal signal corresponding to the data row of the specified time width which the regenerative signal which said maximum-likelihood-decoding means outputs has containing the data row in said specified time width, The data row of said specified time width which the regenerative signal outputted from said regenerative-signal equalization means contains, The data row of said specified time width which the ideal signal which said ideal signal making means created contains is compared, The error signal calculating means which computes an error signal based on this comparison result, and is supplied to said regenerative-signal equalization means, When a repetitive pattern is detected in this, receive the regenerative signal which said maximum-likelihood-decoding means outputs, generate a stop signal, and this, A repetitive pattern detection means to make processing of a means by which supplied at least one in a processing means to receive a regenerative signal from said regenerative-signal equalization means, said maximum-likelihood-decoding means, and said regenerative-signal detection means, to perform prescribed processing, and to supply said regenerative-signal equalization means, and said stop signal was supplied by this hold.

0020 In this invention, the repetitive pattern detector which detects the VFO section of an optical disc can be formed, and degradation of identification performance can be controlled by holding processing of AGC, equalization-modulus control, reference level control, etc. at the time of the VFO section detection. Even if it is the regenerative signal with which asymmetry was contained, the optimal offset level can be calculated and degradation of identification performance can be controlled.

0021 An optical disk unit treating the optical disc which has concentric circle shape or a spiral storage area whose this invention is characterized by that an optical disk unit comprises the following.
A regenerative-signal detection means to detect the regenerative signal which irradiates with a laser beam on the optical disc which rotates with a prescribed rotational frequency, and contains the data row of specified time width according to the waveform pattern of this reflected wave.
The AD translation means which receives a regenerative signal from said regenerative-signal detection means, and carries out the AD translation of this to the digital regenerative signal which is a digital signal.
Offset processing which calculates the amount of gaps from the ideal value of a center level, and subtracts this from a digital regenerative signal about the digital regenerative signal changed by said AD translation means corresponding to the error signal given.
A digital processing means to perform at least one side with the gain control processing which makes the amplification factor of the amplifier of this change and makes change of amplitude a fixed range about said digital regenerative signal, The regenerative-signal equalization means which equalizes said digital regenerative signal which said digital processing means outputted based on a predetermined equalization modulus, A maximum-likelihood-decoding means to decrypt the digital regenerative signal in which equalization was carried out by said regenerative-signal equalization means with a maximum-likelihood-decoding machine, and to output a digital regenerative signal, The ideal signal making means which creates the ideal signal corresponding to the data row of the specified time width which the digital regenerative signal which said maximum-likelihood-decoding means outputs has containing the data row in said specified time width, The data row of said specified time width which the regenerative signal outputted from said regenerative-signal equalization means contains, The error signal calculating means which compares the data row of said specified time width which the ideal signal which said ideal signal making means created contains, computes an error signal based on this comparison result, and is supplied to said digital processing means at least.

0022 According to this invention, compared with a case where offset processing of an analog and gain control processing are performed like before, high-speed control can be performed by performing offset processing and gain control processing for a regenerative signal given from an optical pickup by digital one. Since it is possible to use a conventional offset processing circuit and a gain control processing circuit by an analog about the preceding paragraph of an A/D converter, application to an existing product becomes easy. When giving a control value by a digital signal to an offset processing circuit and a gain control processing circuit, it becomes unnecessary to provide a DA translation.
0023
Mode for carrying out the invention Hereafter, an embodiment of an optical disk unit using a PRML regenerative-signal processing unit applied to this invention using Drawings is described in detail. A block diagram showing a 1st embodiment of a PRML regenerative-signal processing unit which requires drawing 1 for this invention, A block diagram showing a pattern detector with which drawing 2 is used for a PRML regenerative-signal processing unit, a block diagram in which drawing 3 shows an equalization-modulus controller, a block diagram in which drawing 4 shows a reference level controller, a block diagram in which drawing 5 shows offset controllers, and drawing 6 are the block diagrams showing a gain control machine.
0024< a 1st embodiment thru/or, a 6th embodiment : repetitive pattern discernment > a 1st embodiment, It is a PRML regenerative-signal processing unit which prevents degradation of the identification performance of data with identifying the VFO section in an optical disc and holding processing of the processing circuit of a regenerative signal suitably by detecting a repetitive pattern according to this in a regenerative signal.
0025 The PRML regenerative-signal processing unit 1 as a 1st embodiment concerning this invention shown in drawing 1 is provided with the following.
The optical pickup 11 provided near the optical disc D.
The preamplifier 12 which amplifies suitably the regenerative signal given from here.
AD converter 13 which changes into a digital signal the regenerative signal which is an analog signal from the preamplifier 12.

It is connected to AGC15 and this which are performed and AFC14 which comprises a digital circuit which receives the digitized regenerative signal which is supplied from AD converter 13, and performs offset processing, and the gain control which is similarly connected to this and comprises a digital circuit the equalization processing of a regenerative signal. It has the adaptive equalizer 16 constituted as a digital circuit to perform, and the adaptive Viterbi decoder 17 formed as an example of the decoder of a PRML system as the latter part of this. the ideal signal creation circuit 18 which receives the regenerative signal from the adaptive Viterbi decoder 17, and creates an ideal signal further -- and, Although it has the error signal calculation machine 19 which receives the ideal signal and the regenerative signal from the adaptive equalizer 16 which were received from the ideal signal creation circuit 8 and an ideal signal and an error signal are supplied to AFC14, AGC15, the adaptive equalizer 16, and the adaptive Viterbi decoder 17, respectively, Even if all are not necessarily supplied, each control can be carried out to stability in the range supplied, and degradation of identification performance can be controlled. A stop signal also from the repetitive pattern detector 20 which received the regenerative signal from the adaptive Viterbi decoder 17, respectively, AFC14, AGC15, the adaptive equalizer 16, and the adaptive Viterbi decoder 17 are supplied, each control is similarly carried out to stability in the range supplied, and degradation of identification performance is controlled.

0026AFC14 has the offset controllers 22 and the comparator 21 further, AGC15 has the gain control machine 24 and the amplifier 23, the adaptive equalizer 16 has the equalization-modulus controller 26 and the equalizer 25, and the adaptive Viterbi decoder 17 has the reference level controller 28 and the Viterbi decoder 27, respectively.

0027 Operation of the PRML regenerative-signal processing unit 1 by such composition is explained in detail below. That is, information is recorded on an optical disc using an RLL code of d= 1. 4T repetition signal is recorded as VFO. Information recorded on an optical disc is played as a weak analog signal using PUH11. After an analog signal is amplified by the preamplifier 12 and serves as sufficient signal level, it is changed into a digital signal by AD converter 13. As for a digital signal, gain control and the 1st-step offset control are performed by AGC14. Then, 2nd offset control mentioned later is performed. Equalization of the regenerative signal by which offset control was carried out is carried out so that PR (1, 2, 2, 1) characteristic may be filled with the adaptive equalizer 16. From an equalization signal, it is decrypted by the Viterbi decoder 17 to binary decode data.

0028 Next, based on decode data which is a regenerative signal, an ideal signal is computed by the ideal signal creation circuit 18, and an error signal is computed from an ideal signal and an equalization signal with the error signal calculation machine 19. In the equalization-modulus controller 26, an equalization modulus is computed in response to an error signal and a regenerative signal. In the reference level controller 28, reference level is computed in response to an error signal and an ideal signal. Similarly, in the offset controllers 22, an offset amount is computed in response to an error signal and an ideal signal.

0029 Decode data from the Viterbi decoder 17 is sent also to the repetitive pattern detector 20, and in the repetitive pattern detector 20, when decode data is 4T repetition pattern, a stop signal is outputted. In the equalization-modulus controller 26 mentioned above, the reference level controller 28, the offset controllers 22, and AGC15, while a stop signal is outputted from the repetitive pattern detector 20, adaptive control is suspended, and the last value is held. During 4T repetition pattern reproduction, even when regenerative-signal envelopes differ by the VFO section and a data division by suspending various adaptive control, a phenomenon in which a gain shifts at the data division head as shown by drawing 25 can be avoided. Even when the VFO section differs in the regenerative-signal characteristic from a data division, it becomes possible to control an increase in convergence time of an equalization modulus, reference level, and an offset amount, and emission.

0030 Next, an example of composition of a repetitive pattern detector is shown in drawing 2. In drawing 2, decode data is delayed by the 8xn unit delay elements 31 one by one, and n data for every 8 bits is calculated by AND circuit 32 and OR circuit 33. If an output of the NXOR circuits 34 and 35 is calculated per OR result with an AND result and all of n data are in agreement, a NXOR result will be set to 1 and will be set to 0 except it. By a calculation result of an AND circuit, an AND result is outputted as a stop signal per NXOR output of eight pieces.

0031 In the repetitive pattern detector 20, when n or more patterns of eight bit periods are

recorded continuously, "1" is outputted as a stop signal, and when other, "0" is outputted. If the value of n is small, it will react also to the repetitive pattern which comes out in a data division by chance. On the contrary, in spite of being the VFO section when the value of n is large, and an error occurs in the VFO section, various adaptive control will resume operation. If these are taken into consideration, 4<=n<=32 can say that it is a suitable value.

0032 Next, an example of the composition of an equalization-modulus controller is shown in drawing 3. Although a fundamental function has the portion which was common in the thing of drawing 20, it differs in that "0" is changed to an error signal by a stop signal. That is, the equalization-modulus controller 26 is provided with the following.
The switch element 36 which controls switching of an error signal by a stop signal.
Two or more delay devices 37 and 38 delayed in a regenerative signal.
The operator 39, the accumulation machine 40, and two or more comparators 41 and storage cells 42 of two or more.

0033 In such composition, when a stop signal is "0", it is connected to the error signal side and the switch element 36 operates as a usual adaptive equalization machine. On the other hand, when a stop signal is "1", the switch element 36 is connected to the earth side, and an equalization modulus is held, for example, stability of operation is obtained also in the VFO section.

0034 Next, an example of composition of a reference level controller is shown in drawing 4. The reference level controller 28 is provided with the following.
The switch element 45 which switches an error signal with a stop signal.
The switch elements 46 and 47 which switch power supply potential with an ideal signal.
Two or more counters 48 and accumulation machines 49 which are connected to this, respectively.
Two or more switch elements 50 connected to these, respectively, two or more amplifiers 51 connected to these, two or more comparators 52 connected to these, and two or more storage cells 53 connected to parallel at these, respectively.

0035 The reference level controller 28 with such composition operates as follows. First, operation in case a stop signal is 0 is described. Corresponding to a level of an ideal signal, a switch can distribute an error signal, and it is respectively inputted into the accumulation machine 49. At this time, the number of times of occurrence of each level is simultaneously counted at the counter 48. For every predetermined time, division of the accumulation result is done by the number of times of occurrence for every level, and update values are calculated by carrying out the multiplication of the control sensitivity beta (0< beta<=1) to a divided result. By adding update values to the last reference level, reference level is computed newly. However, initial values of reference level are 0, 1, 2, 3, 4, 5, and 6 respectively, and, as for a power up, these values are stored in the memory 53. When updating reference level, the counter 48 and the accumulation machine 49 are reset. When a stop signal is "1", "0" is chosen by the switch element 45 instead of an error signal. As a result, a value of an accumulation machine is set to "0", reference level will be held, and stability of operation is obtained also, for example in the VFO section.

0036 Next, an example of the composition of offset controllers is shown in drawing 5. The offset controllers 22 are provided with the following.
The switch element 57 which switches an error signal with a stop signal.
The switch element 58 by which the switching is controlled by the output of the center level detector 55 which received the ideal signal.
The accumulation machine 59 connected to the output of this.
It has the counter 56 which undergoes the output of the center level detector 55, the switch element 60 which switches the output of the accumulation machine 59 with the output of the counter 56, and the amplifier 61 which amplifies this output and also the comparator 62 by which multiple connection was carried out to the memory 63.

0037 Operation of the offset controllers 22 with such composition is explained. First, operation in case a stop signal is 0 is described. An error signal is sent to the accumulation machine 59, only when an ideal signal is the center level 3, i.e., a level. At this time, the number of times of occurrence of a center level is carried out count 56 simultaneously. For every predetermined time, division of the accumulation value is done by the number of times of occurrence, and update values are calculated by carrying out the multiplication of the control sensitivity gamma (0<

gamma<=1) to a divided result. By adding update values to the last offset value, an offset value is computed newly. However, the initial value of an offset value is "0" and, as for the power up, "0" is stored in the memory. When updating an offset value, the value of the counter 56 and the accumulation machine 59 is reset. When a stop signal is "1", "0" is chosen by the switch element 57 instead of an error signal. as a result, an accumulation value is set to "0" and an offset value is held -- things -- a sake -- for example, the VFO section -- also setting -- stability of operation -- obtaining -- having .

0038 It becomes possible to be able to compute the optimal offset amount and to control degradation of identification performance as a result by it by this, even when asymmetry is contained in the regenerative signal by use of the offset controllers of drawing 5.

0039 As mentioned above, the offset controllers 22 of drawing 5 are the same as the portion corresponding to the level 3 of the reference level controller 28 of drawing 4 except for a renewal period, updating sensitivity, and an initial value so that clearly from drawing 4 and comparison of 5. When the renewal period of the offset controllers 22 and the reference level controller 28 is the same, some reference level controllers 28 can be shared as the offset controllers 22.

0040 An example of the composition of an AGC circuit is shown in drawing 6. That is, AGC circuit 24 of drawing 6 is provided with the following.

The switch element 74 which switches an error signal with a stop signal.

The switch element 75 which switches with the output of the minimum level detector 72 which receives an ideal signal.

The accumulation machine 76 which undergoes this output.

It has the switch element 77 which switches the accumulation machine 76 with the output of the counter 73 and counter which undergo the output of the minimum level detector 72.

0041 Similarly, it has the switch element 68 which switches an error signal with a stop signal, the switch element 69 which switches with the output of the maximum level detector 66 which receives an ideal signal, and the accumulation machine 70 which undergoes this output. It has the switch element 71 which switches the accumulation machine 70 with the output of the counter 67 and counter which undergo the output of the maximum level detector 66.

0042 It has the comparator 78 which measures the output of these two switch elements 71 and 77, the amplifier 79 which amplifies this output, and the comparator 81 which measures that output and the output of the amplifier 80 which went via the memory 82, and this output is supplied as a gain.

0043AGC circuit 24 which has such composition operates as follows. That is, when a stop signal is "0", from a regenerative signal, an offset value and signal amplitude are calculated and offset control and a gain adjustment are performed using these values. When a stop signal is "1", an offset value and signal amplitude are held and offset control and a gain adjustment are performed with the held value. Thereby, stability of operation is obtained also, for example in the VFO section.

0044 As explained above, in the PRML regenerative-signal processing unit concerning this invention. During repetitive pattern reproduction, by holding an equalization modulus, reference level, an offset level, and a gain level, each control can be carried out to stability and degradation of identification performance can be controlled by detecting a repetitive pattern from decode data.

0045 In the PRML regenerative-signal processing unit concerning this invention, the offset amount of a center level can be computed using decode data and an equalization signal, and degradation of identification performance can be controlled by carrying out offset control of a regenerative signal using the computed offset amount.

0046 According to the embodiment mentioned above, although the cycle of the repetitive pattern was 8 bits, it is applicable to other repeating cycles.

0047 In the embodiment mentioned above, although equalization-modulus control, reference level control, offset control, and gain control were performed, it is also possible to use it, as it is not necessary to perform all simultaneously and only these parts were mentioned above.

0048 In the embodiment mentioned above, although the example of PR (1, 2, 2, 1) characteristic and the RLL code of d= 1 was shown, even when other PR characteristics and an RLL code are used, this invention can be applied and can demonstrate the same operation effect.

0049A 2nd embodiment is a PRML regenerative-signal processing unit supplying the stop signal from a repetitive pattern detector only to an adaptive equalizer. Drawing 7 is a block diagram

showing a 2nd embodiment of the PRML regenerative-signal processing unit concerning this invention. In drawing 7, unlike the PRML regenerative-signal processing unit of drawing 1, instead of the adaptive Viterbi decoder, the fixed Viterbi decoder 102 which receives neither an ideal signal nor an error signal nor the stop signal from the repetitive pattern detector 20 from the exterior is used, and the given constant performs decoding processing. AFC and AGC which are given as a digital circuit in the case of drawing 1 are provided as analog AFC106 and analog AGC107, and other composition is common.

0050 In such composition, the adaptive equalizer 16 is receiving a stop signal from the repetitive pattern detector 20 in processing in the VFO section, when a stop signal is "0", it is connected to the error signal side and the switch element 36 of drawing 3 operates as a usual adaptive equalization machine. It is that the switch element 36 is connected to the earth side, and an equalization modulus is held on the other hand when a stop signal is "1", and it is possible to obtain stability of operation also, for example in the VFO section. Thus, work of a repetitive pattern detector and a stop signal concerning this invention does not necessarily need to be supplied to two or more treating parts, and even if it works on only the adaptive equalizer 16, it has a operation effect in the range.

0051A 3rd embodiment is a PRML regenerative-signal processing unit supplying a stop signal from a repetitive pattern detector to an adaptive equalizer and an adaptive Viterbi decoder. Drawing 8 is a block diagram showing a 3rd embodiment of a PRML regenerative-signal processing unit concerning this invention. AFC and AGC to which a PRML regenerative-signal processing unit which drawing 8 shows is given as a digital circuit by drawing 1 unlike a thing of drawing 1 are provided as analog AFC106 and analog AGC107, and other composition is common.

0052 Also in such composition, according to the stop signal from the repetitive pattern detector concerning this invention, when a stop signal is "1", about an adaptive equalizer and an adaptive Viterbi decoder, It becomes possible to obtain stability of operation also, for example in the VFO section with an equalization modulus and reference level being held, respectively.

0053 It is a PRML regenerative-signal processing unit, wherein a 4th embodiment supplied the stop signal from a repetitive pattern detector only to AFC14 and AGC15 and uses an equalizer and the Viterbi decoder as a cover half, respectively. Drawing 9 is a block diagram showing a 4th embodiment of the PRML regenerative-signal processing unit concerning this invention. Instead of the equalizer and the Viterbi decoder with which the PRML regenerative-signal processing unit which drawing 9 shows was given as adaptive by drawing 1 unlike the thing of drawing 1, the cover-half equalizer 101 and the cover-half Viterbi decoder 102 are formed, and other composition is common.

0054 Also in such composition, according to a stop signal from a repetitive pattern detector concerning this invention, when a stop signal is "0", an offset value and signal amplitude are calculated from a regenerative signal, and offset control and a gain adjustment are performed using these values. When a stop signal is "1", an offset value and signal amplitude are held and offset control and a gain adjustment are performed with a held value. This becomes possible to obtain stability of operation also, for example in the VFO section.

0055 It is a PRML regenerative-signal processing unit, wherein a 5th embodiment supplied a stop signal from a repetitive pattern detector to AFC14, AGC15, and an adaptive equalizer and uses the Viterbi decoder as a cover half. Drawing 10 is a block diagram showing a 5th embodiment of a PRML regenerative-signal processing unit concerning this invention. Instead of the Viterbi decoder with which a PRML regenerative-signal processing unit which drawing 10 shows was given as adaptive by drawing 1 unlike a thing of drawing 1, a cover-half Viterbi decoder is formed and other composition is common.

0056 Also in such composition, it is common in a 1st embodiment, and about the processing circuit where the stop signal was given, suitably, a control value is held and performs offset control, a gain adjustment, and equalization processing with the held value. This becomes possible to obtain stability of operation also, for example in the VFO section.

0057 Although a 6th embodiment is the PRML regenerative-signal processing unit which supplied the stop signal from a repetitive pattern detector to AFC14, AGC15, the adaptive equalizer, and the adaptive Viterbi decoder like a 1st embodiment, It is characterized by providing analog AFC and analog AGC in the preceding paragraph of a digital circuit region.

0058 Drawing 11 is a block diagram showing a 6th embodiment of the PRML regenerative-signal

processing unit concerning this invention. The PRML regenerative-signal processing unit which drawing 11 shows differs from the thing of drawing 1, In the digital circuit region which comprises LSI of a digital circuit, etc., this case. It becomes the feature to have provided analog AFC106 and analog AGC107 into the analog circuit region usually established in the preceding paragraph of the field formed as one as circuits, such as LSI of analog circuitry, in the digital circuit after AFC14. That is, even if constituted combining analog LSI conventionally designed as elegance, and digital LSI which has the feature of new this invention, in order not to interfere on operation, a possibility that such composition will appear is high.

0059 Also in such composition, this invention can demonstrate a operation effect equivalent to a 1st embodiment, and a PRML regenerative-signal processing unit which can obtain stability of operation also in the VFO section of an optical disc can be provided.

0060 It is preferred to have the following specifications about composition of drawing 15 which drawing 11 which combined the conventional offset controllers and gain control machine in this case, and offset controllers and a gain control machine of this invention constitutes and also mentions later, drawing 16, and drawing 17.

0061 That is, the reliability of identification data improves by changing the control band of the offset controllers which are the conventional analog circuitry, the offset controllers which are the digital circuits of this invention and the gain control machine which is the conventional analog circuitry, and the gain control machine which is the digital circuits of this invention. When the control band of the conventional offset controllers and a gain control machine is respectively set to BWafc1 and BWagc1 and the control band of the offset controllers of this invention and a gain control machine is specifically respectively set to BWafc2 and BWagc2, It is determined that it is set to 2<BWafc2/BWafc1<10002<BWagc2/BWagc1<1000 by the control band. Thereby, it becomes possible to raise the reliability of identification data.

0062< a 7th embodiment thru/or, a 12th embodiment: Digital AFC-AGC> a 7th embodiment is a PRML regenerative-signal processing unit using AFC and AGC which comprised a digital circuit concerning this invention. The repetitive pattern detector made indispensable at a 1st embodiment is not used for the embodiment after a 7th embodiment.

0063digital one which drawing 12 requires for this invention -- it is a block diagram showing a 7th embodiment of the PRML regenerative-signal processing unit using AFC and AGC. In drawing 12, although drawing 9 in which a 4th embodiment was shown, and fundamental composition are common, it is making not to form the repetitive pattern detector 20 into the point of difference.

0064digital one which starts this invention by such composition -- the following operation effects are demonstrated by providing AFC and AGC. That is, since the ideal signal from the ideal signal creation circuit 18 and the error signal from the error signal calculation machine 19 are given as a control signal of a digital signal, in AFC and AGC as conventional analog circuitry, the necessity for a required DA translation of them is lost. Compared with AFC and AGC by analog circuitry, high speed processing is further made possible by being referred to as AFC and AGC by a digital circuit. moreover -- further -- digital one of this invention -- it also becomes a thing of the type with which AFC and AGC as analog circuitry exist in the A/D converter preceding paragraph applicable also when newly introducing AFC and AGC into the conventional system.

0065 Thereby, AFC14 follows a main change of the regenerative signal from an optical disc, and it carries out variable control of the offset amount so that the DC component of an output signal may become zero. AGC15 follows the amplitude fluctuation to which the regenerative signal from an optical disc is changed every moment, and it carries out variable control of the amplification factor so that the amplitude of an output signal may become fixed.

0066 An 8th embodiment is a PRML regenerative-signal processing unit using AFC and AGC which comprised a digital circuit similarly, and takes the form which adds the error signal from an error signal calculation machine to AFC and AGC, and is supplied also to the adaptive equalizer 16. Drawing 13 shows this and shows the structure where the error signal from an error signal calculation machine is supplied also to the adaptive equalizer 16. Also in this composition, the same operation effect as a 7th embodiment is shown.

0067A 9th embodiment is a PRML regenerative-signal processing unit using AFC and AGC which comprised a digital circuit similarly, and takes the form which adds the error signal from an error signal calculation machine to AFC and AGC, and is supplied also to the adaptive equalizer 16 and the adaptive Viterbi decoder 17. Drawing 14 shows this and the structure where the error signal

from an error signal calculation machine is supplied also to the adaptive equalizer 16 and the adaptive Viterbi decoder 17 is shown, Also in this composition, like a 7th embodiment and an 8th embodiment, a DA converter is made unnecessary and high speed processing is made possible compared with AFC and AGC of analog circuitry.

0068a 10th embodiment -- a 7th embodiment -- in addition, the former using analog AFC and analog AGC of the conventional type -- elegance -- digital one of this invention -- the form to which AFC and AGC were made to apply is shown. Also in this composition shown in drawing 15, like a 7th embodiment etc., a DA converter is made unnecessary and high speed processing is made possible compared with AFC and AGC of analog circuitry.

0069an 11th embodiment -- an 8th embodiment -- in addition, the former using analog AFC and analog AGC of the conventional type -- elegance -- digital one of this invention -- the form to which AFC and AGC were made to apply is shown. Also in this composition shown in drawing 16, like a 7th embodiment etc., a DA converter is made unnecessary and high speed processing is made possible compared with AFC and AGC of analog circuitry.

0070a 12th embodiment -- a 9th embodiment -- in addition, the former using analog AFC and analog AGC of the conventional type -- elegance -- digital one of this invention -- the form to which AFC and AGC were made to apply is shown. Also in this composition shown in drawing 17, like a 7th embodiment etc., a DA converter is made unnecessary and high speed processing is made possible compared with AFC and AGC of analog circuitry.

0071 By as mentioned above, the thing for which AFC and AGC which comprised a digital circuit concerning this invention are used about a 7th embodiment thru/or a 12th embodiment. Application to LSI of AFC and AGC of the analog circuitry of elegance, etc. is conventionally made easy, and the PRML regenerative-signal processing unit which realizes high speed processing, and the optical disk unit using this can be provided, enabling supply to each processing circuit of a digital control signal without using a DA converter.

0072<Optical disk unit with which PRML regenerative-signal processing unit of this invention is applied> (basic constitution) drawing 18 is a figure showing the composition of the whole optical disk unit with which the PRML regenerative-signal processing unit concerning this invention is applied. In this figure, optical disk unit A performs Data Recording Sub-Division or data reproduction to optical disc D. The above-mentioned optical disk unit A is provided with the following.

The tray 132 which conveys optical disc D stored by the disk cartridge.

The motor 33 which drives this tray.

The clamping circuit 134 holding optical disc D.

The spindle motor 135 made to rotate optical disc D held by this with a prescribed rotational frequency.

CPU146 which performs the whole motion control as a control section, ROM147 which store the fundamental program of this control action, etc., and RAM148 which store each control program, application data, etc. so that rewriting is possible are connected via the control bus. The feed motor 136 which is connected to the control section of these CPU146 grades, respectively, and conveys the pickup PU, The focus and tracking control of a pickup. The focus / tracking actuator driver / delivery Motor Driver 140 to perform and also the spindle motor driver 141 which drives the spindle motor 135, and tray Motor Driver 142 which drives a tray motor are formed, respectively.

0073RAM143 for storing the data processing unit 3 for processing the preamplifier 12 which is connected to the pickup PU and amplifies a detecting signal further, the pickup PU and the preamplifier 12, a detecting signal, and a record signal, and the data used for this various processing is provided. The interface control 145 is formed with RAM144 in order to transmit and receive the signal from this data processing unit 3 between external devices.

0074 In such an optical disk unit, in the data processing unit 3 as shown in drawing 18 by this invention, With constituting including AFC14, such as drawing 1 mentioned above, AGC15, the adaptive equalizer 16, the adaptive Viterbi decoder 17, the ideal signal creation circuit 18, the error signal calculation machine 19, and repetitive pattern detector 20 grade. The optical disk unit which realizes a 1st embodiment thru/or a 12th embodiment mentioned above, respectively is made possible.

0075(Processing operation) The optical disk unit formed in the enforcement of this invention which

has such composition performs regeneration and recording processing of an optical disc as follows. Namely, if optical disk unit A is loaded with optical disc D, the pickup PU and the data processing unit 3 will be used, The control information on optical disc D currently recorded on the control data zone in the embossing data zone of read in area of optical disc D is read, and CPU146 is supplied.

0076 In the bottom of control of CPU146 based on the control information on optical disc D currently recorded on the control data zone in the operation information by a user's operation, or an optical disc in optical disk unit **of this invention** A, the present status, etc., It is energized with the laser control unit which is not illustrated, and a laser beam is generated.

0077 It converges with the object lens 131 and the generated laser beam is irradiated to the record section of a disk. Thereby, data is recorded on the storage area of optical disc D (generation of mark rows: with a variable-length mark and the interval of a mark.). Or data is recorded on optical disc D by the length of each variable-length mark, the reflected wave corresponding to the data stored is reflected, this is detected, and playback of this data is performed.

0078 This optical disc D is stored by direct or the disk cartridge, and is conveyed in equipment on the tray 132 so that optical disc D may counter the object lens 131 and may be arranged. The tray motor 133 for driving this tray 132 is formed in equipment. Optical disc D with which it was loaded is held by the clamping circuit 134 on the spindle motor 135 pivotable, and rotates to a prescribed rotational frequency with this spindle motor 135.

0079 The pickup PU has a photodetector (not shown) which detects a laser beam to the inside of it. This photodetector detects the laser beam which was reflected by optical disc D and returned via the object lens 131. The detecting signal (current signal) from a photodetector is changed into a voltage signal with current/voltage converter (I/V), and this signal is supplied to the preamplifier 12 and the servo amplifier 134. From the preamplifier 12, the signal for reproduction of the object for reproduction of the data of a header unit and the data of a record section is outputted to the data processing unit 3.

0080 Here, methods of detecting the amount of focal gaps optically include the following astigmatic method and the knife-edge method, for example. It is the method of detecting the shape change of the laser beam which arranges the optical element (not shown) which makes the detecting optical path of a laser beam reflected with astigmatic method, i.e., the light reflection film layer of optical disc D, or light reflex nature record film generating astigmatism, and is irradiated on a photodetector. The photodetection field is quadrisected in the shape of a diagonal line. The difference of diagonal Hotan is taken within the servo seek control unit which is not illustrated to the detecting signal acquired from each detection area, and a focus-error-detection signal (focusing signal) is acquired. It is the knife-edge method, i.e., the method of arranging knife edge which shades a part asymmetrically to the laser beam reflected by optical disc D. A photodetection field is divided into two, takes the difference between the detecting signals acquired from each detection area, and acquires a focus-error-detection signal. Usually, either the above-mentioned astigmatic method or the knife-edge method is adopted.

0081 Optical disc D has a track of spiral shape or concentric circle shape, and information is recorded on a track. Condensing spot is made to trace along this track, and reproduction of information, or record/elimination is performed. In order to be stabilized and to make condensing spot trace along a track, it is necessary to detect a relative location gap of a track and condensing spot optically.

0082 Generally as a track-deviation detecting method, at least that of the following has phase reference detection system, the push pull method, the twin spotting method, etc. The intensity distribution change on the photodetector of the laser beam reflected with a phase-difference-detection (Differential Phase Detection) method, i.e., the light reflection film layer of optical disc D, or light reflex nature record film is detected. The photodetection field is quadrisected on the diagonal line. To the detecting signal acquired from each detection area, the phase contrast of diagonal Hotan is taken within the servo seek control unit 39, and a track error detecting signal (tracking signal) is acquired. In the push pull (Push-Pull) method, i.e., this method, the intensity distribution change on the photodetector of the laser beam reflected by optical disc D is detected. A photodetection field is divided into two, takes the difference between the detecting signals acquired from each detection area, and acquires a track error detecting signal. A diffraction element etc. are arranged in the light transmission system between the twin spotting (Twin-Spot) methods, i.e., a semiconductor laser element and the optical disc D, wavefront splitting of the light is carried out to

plurality, and reflected-light-quantity change of the primary ** diffracted light with which it irradiates on optical disc D is detected. The photodetection field which detects the reflected light quantity of the primary + diffracted light and the reflected light quantity of -primary diffracted light separately apart from the photodetection field for regenerative-signal detection is arranged, the difference of each detecting signal is taken, and a track error detecting signal is acquired.
0083 From the servo seek control unit which is not illustrated by such focus control and track control to a focusing signal. A tracking signal and a delivery signal send to a focus and a tracking actuator driver row, and are sent to Motor Driver 140, focus servo control of the object lens 131 is carried out by this driver 140, and tracking servo control is carried out. According to an access signal, an energization signal is supplied to the feed motor 136 from the driver 140, and the transfer control of the pickup PU is carried out.
0084 The spindle motor driver 141 and tray Motor Driver 142 are controlled by the control signal from the data processing unit 3, The spindle motor 135 and the tray motor 133 will be energized, the spindle motor 135 will rotate with a prescribed rotational frequency, and the tray motor 133 will control a tray appropriately.
0085 The regenerative signal S corresponding to the data of the header unit supplied to the data processing unit 3 is supplied to CPU146. Thereby, CPU146 judges the sector number as an address of a header unit with the regenerative signal S, and performs comparison with the sector number as an address (the data which records data or is recorded is reproduced) to access.
0086 The regenerative signal S corresponding to data of a record section supplied to the data processing unit 3. Data required for RAM148 is stored, the regenerative signal S is processed with this data processing unit 3, and the interface control 145 is supplied, for example, a regeneration signal is supplied to external devices, such as a personal computer.
0087 In such optical disk unit A, a characterizing portion of a PRML regenerative-signal processing unit concerning a 1st embodiment thru/or a 12th embodiment of this invention mentioned above is mainly given as composition of the data processing unit 3, and a operation effect mentioned above is demonstrated.
0088 That is, in a 1st embodiment thru/or a 6th embodiment, the VFO section of an optical disc can mainly be detected using the repetitive pattern detector 20, and degradation of identification performance can be controlled by carrying out hold processing of the control value of each control section only in the meantime. Furthermore, in a 7th embodiment thru/or a 12th embodiment, it is mainly providing AFC and AGC as a digital circuit, and an optical disk unit which realizes high-speed control management is provided, making a DA converter etc. unnecessary.
0089 By each embodiment explained in full detail above, the person skilled in the art can realize this invention. However, it is possible to apply a principle in a large meaning in which various modifications of these embodiments are in ** easily, and were indicated by person skilled in the art to various embodiments, even if it does not have invention capability. Thus, it cannot be overemphasized that it is not what is limited to an embodiment which this invention attains to an extensive range which is not contradictory to an indicated principle with the new feature, and was mentioned above.
0090
Effect of the Invention According to this invention, as explained in full detail above, form the repetitive pattern detector which detects the VFO section of an optical disc, and at the time of the VFO section detection. The optical disk unit which can control degradation of identification performance can be provided by holding processing of AGC, equalization-modulus control, reference level control, etc.
0091 The regenerative signal which is given from an optical pickup according to this invention by performing offset processing and gain control processing by digital one, The optical disk unit which can perform high-speed control as unnecessary in a DA translation etc. compared with the case where offset processing of analog circuitry and gain control processing are performed like before is provided.

Field of the Invention This invention is an optical disk unit and relates to the optical disk unit especially using a PRML system.

Description of the Prior Art These days, the optical disk unit which performs record reproduction processing to optical discs, such as DVD (Digital Versatile Disc), has spread widely, and it is produced commercially by performing development with various systems. For example, as a system of record reproduction processing of an optical disk unit, there is a PRML (Partial Response and Maximum Likelihood) system, and drawing 19 shows the general composition of the optical disk unit which used this system.

0003 In drawing 19, the information recorded on the optical disc is played as a weak analog signal using PUH (pickup head-ick Up Head). After an analog signal is amplified by a preamplifier and set to sufficient signal level, AFC of an analog () **Auto Offset Controller and** AGC of an analog set to automatic offset-controllers and following AFC () **Auto Gain Controller and** an automatic-gain-control machine and following AGC -- carrying out -- offset and a gain are adjusted, then it is changed into a digital signal by an AD converter (Analog to Digital Converter). After equalization of the digitized regenerative signal is carried out so that a predetermined PR characteristic may be approached according to an error signal with an adaptive equalizer, it obtains binary decode data with an adaptive Viterbi decoder.

0004 The composition of the equalization-modulus controller used for an adaptive equalizer is shown in drawing 20. Four unit delay elements by which cascade connection was carried out so that the regenerative signal by which phase adjustment was carried out with the delay device might be delayed, Five multipliers which perform the multiplication of input and output and the error signal of these unit delay elements, It comprises an accumulation machine which carries out accumulation of the output of a multiplier respectively, a multiplier which multiplies the output of an accumulation machine by the control sensitivity alpha (0< alpha<1), an adding machine adding the present equalization modulus set as the output and equalizer of a multiplier, and a memory holding the present equalization modulus.

0005 Thus, the equalizer which controlled the equalization modulus according to change of a regenerative signal is called an adaptive equalization machine, and it is indicated by Journal of the Institute of Electronics, Information and Communication Engineers Vol.81, No.5, and pp.497-505 (May, 1998) about the adaptive equalization machine, for example.

0006 The composition of the reference level controller used for an adaptive Viterbi decoder is shown in drawing 21. This calculates reference level from an equalization signal and the survival path computed from the pass memory in the Viterbi decoder. The average value of the value which was accumulated in two or more memories which survived the equalization signal and were divided for every level using the path, and was accumulated in the memory for every level is calculated, and let it be reference level.

0007 Next, various PR characteristics are explained using drawing 22. (a) - (d) of drawing 22 shows record data, a recording waveform, a pit sequence, and a regenerative waveform, respectively. The waveform after equalization when an equalizer performs equalization based on PR (1, 1) characteristic, PR (1, 2, 1) characteristic, and PR (1, 2, 2, 1) characteristic is shown in (e) of drawing 22, (f), and (g) to the regenerative waveform of (d) of drawing 22, respectively. PR (1, 1) characteristic means the characteristic of appearing at a rate of 1:1 respectively at two identification points when an impulse response continues. PR (1, 2, 1) characteristic means the characteristic of appearing at a rate of 1:2:1 respectively at three identification points when an impulse response continues. PR (1, 2, 2, 1) characteristic means the characteristic of appearing at a rate of 1:2:2:1 respectively at four identification points when an impulse response continues. The same can be said for the PR characteristic which is others although not illustrated.

0008 It turns out that the waveform after equalization has the characteristic which became blunt in order of the PR (1, 1) characteristic ->PR (1, 2, 1) characteristic ->PR (1, 2, 2, 1) characteristic as shown in (e) of drawing 22, (f), and (g). In a PRML system, the increase in the signal deterioration ingredient in an equalizer can be controlled by carrying out waveform equalization to the PR characteristic near the characteristic of a regenerative waveform.

0009 Generally in the regenerative-signal processor of a PRML system, the Viterbi decoder which is typical one of the maximum-likelihood-decoding machines is used for the detector arranged after an equalizer. Supposing equalization of the regenerative waveform is carried out with an equalizer

to PR (1, 2, 2, 1) characteristic, out of all the series with which PR (1, 2, 2, 1) characteristic is filled, an error with the sample sequence of an equalization signal will choose the smallest series, and the Viterbi decoder will output the decode data corresponding to the selected series. In order to carry out from two or more sampled values in a PRML system rather than to decode from one sampled value, the tolerance over the signal deterioration ingredient which does not have correlation between sampled values is strong.
0010 In the optical disc which such an optical disk unit treats. The repetitive pattern called VFO (Variable Frequency Oscillator, a variable frequency oscillator, and the following are referred to as VFO) used for drawing in of a PLL (Phase Lock Loop) circuit other than the data which should be recorded essentially, etc. is recorded. As a pattern of VFO, what is called a 4T repetition pattern of 000011110000111 -- is used. When storage density is high, as drawing 24 shows, regenerative-signal envelopes differ by the VFO section and a data division.
0011 However, as (a) of drawing 25 shows in this way, when regenerative-signal envelopes differ by the VFO section and a data division, in order to amplify the regenerative-signal envelope of the VFO section to predetermined amplitude in an automatic gain control circuit, The regenerative-signal envelope immediately after a data division start will become larger than predetermined, and as shown in (b) of drawing 25, degradation of identification performance will be caused.
0012 By the VFO section and a data division, when carrying out the adaptive control of the equalization modulus as shown in (c) of drawing 25 since the regenerative-signal characteristics differ, the VFO section will differ in the RMS (Root Mean Square) value of an error signal greatly from a data division. There is a problem that this causes the increase in the convergence time of equalization-modulus control and emission of an equalization modulus, and also the difference of the regenerative-signal characteristic of the VFO section and a data division invites the instability of reference level also to reference level control.
0013 The vertical asymmetry called asymmetry as shown in the graph of drawing 26 is included in a still more nearly actual regenerative signal. In this case, in the conventional automatic gain control circuit, the level **level / which makes identification performance best** shifted is put in order as an offset level.

Effect of the Invention According to this invention, as explained in full detail above, form the repetitive pattern detector which detects the VFO section of an optical disc, and at the time of the VFO section detection. The optical disk unit which can control degradation of identification performance can be provided by holding processing of AGC, equalization-modulus control, reference level control, etc.
0091 The regenerative signal which is given from an optical pickup according to this invention by performing offset processing and gain control processing by digital one, The optical disk unit which can perform high-speed control as unnecessary in a DA translation etc. compared with the case where offset processing of analog circuitry and gain control processing are performed like before is provided.

Problem to be solved by the invention Namely, it is AGC when regenerative-signal envelopes differ by the VFO section and a data division in the conventional optical disk unit, In order to amplify the regenerative-signal envelope of the VFO section to predetermined amplitude, the regenerative-signal envelope immediately after a data division start becomes larger than predetermined, and there is a problem of causing degradation of identification performance.
0015 Since the VFO section differs in the regenerative-signal characteristic from a data division, when the adaptive control of the equalization modulus is carried out, By the VFO section and a data division, the RMS (Root Mean Square) values of an error signal differ greatly, and The increase in the convergence time of equalization-modulus control, Or emission of an equalization modulus is caused and the difference of the regenerative-signal characteristic of the VFO section and a data division has the problem of making reference level unstable also in reference level control.
0016 The vertical asymmetry called asymmetry is included in a still more nearly actual

regenerative signal, and there is a problem of putting in order the level **level / which makes identification performance best** shifted as an offset level in it, by the conventional AGC.
0017 In the further conventional optical disk unit, since the offset control by AFC of an analog and the gain control by AGC of an analog are used, it is necessary to carry out the DA translation of the control value by digital one and, and there is a problem that sufficient high-speed control cannot be performed.
0018 This invention is detecting the repetitive pattern of a regenerative signal, identifying the VFO section, and holding each processing, and an object of this invention is to provide the optical disk unit which controls degradation of identification performance and obtains stability of operation.

Means for solving problem An optical disk unit treating the optical disc which has concentric circle shape or a spiral storage area whose this invention is characterized by that an optical disk unit comprises the following.
A regenerative-signal detection means to detect the regenerative signal which irradiates with a laser beam on the optical disc which rotates with a prescribed rotational frequency, and contains the data row of specified time width according to the waveform pattern of this reflected wave.
The regenerative-signal equalization means which equalizes said regenerative signal which determined the equalization modulus based on the error signal given, and the regenerative-signal detection means outputted according to this.
A maximum-likelihood-decoding means to decrypt the regenerative signal in which equalization was carried out by said regenerative-signal equalization means with a maximum-likelihood-decoding machine, and to output a regenerative signal.
The ideal signal making means which creates the ideal signal corresponding to the data row of the specified time width which the regenerative signal which said maximum-likelihood-decoding means outputs has containing the data row in said specified time width, The data row of said specified time width which the regenerative signal outputted from said regenerative-signal equalization means contains, The data row of said specified time width which the ideal signal which said ideal signal making means created contains is compared, The error signal calculating means which computes an error signal based on this comparison result, and is supplied to said regenerative-signal equalization means, When a repetitive pattern is detected in this, receive the regenerative signal which said maximum-likelihood-decoding means outputs, generate a stop signal, and this, A repetitive pattern detection means to make processing of a means by which supplied at least one in a processing means to receive a regenerative signal from said regenerative-signal equalization means, said maximum-likelihood-decoding means, and said regenerative-signal detection means, to perform prescribed processing, and to supply said regenerative-signal equalization means, and said stop signal was supplied by this hold.

0020 In this invention, the repetitive pattern detector which detects the VFO section of an optical disc can be formed, and degradation of identification performance can be controlled by holding processing of AGC, equalization-modulus control, reference level control, etc. at the time of the VFO section detection. Even if it is the regenerative signal with which asymmetry was contained, the optimal offset level can be calculated and degradation of identification performance can be controlled.
0021 An optical disk unit treating the optical disc which has concentric circle shape or a spiral storage area whose this invention is characterized by that an optical disk unit comprises the following.
A regenerative-signal detection means to detect the regenerative signal which irradiates with a laser beam on the optical disc which rotates with a prescribed rotational frequency, and contains the data row of specified time width according to the waveform pattern of this reflected wave.
The AD translation means which receives a regenerative signal from said regenerative-signal detection means, and carries out the AD translation of this to the digital regenerative signal which is a digital signal.
Offset processing which calculates the amount of gaps from the ideal value of a center level, and subtracts this from a digital regenerative signal about the digital regenerative signal changed by

said AD translation means corresponding to the error signal given.
A digital processing means to perform at least one side with the gain control processing which makes the amplification factor of the amplifier of this change and makes change of amplitude a fixed range about said digital regenerative signal, The regenerative-signal equalization means which equalizes said digital regenerative signal which said digital processing means outputted based on a predetermined equalization modulus, A maximum-likelihood-decoding means to decrypt the digital regenerative signal in which equalization was carried out by said regenerative-signal equalization means with a maximum-likelihood-decoding machine, and to output a digital regenerative signal, The ideal signal making means which creates the ideal signal corresponding to the data row of the specified time width which the digital regenerative signal which said maximum-likelihood-decoding means outputs has containing the data row in said specified time width, The data row of said specified time width which the regenerative signal outputted from said regenerative-signal equalization means contains, The error signal calculating means which compares the data row of said specified time width which the ideal signal which said ideal signal making means created contains, computes an error signal based on this comparison result, and is supplied to said digital processing means at least.

0022 According to this invention, compared with a case where offset processing of an analog and gain control processing are performed like before, high-speed control can be performed by performing offset processing and gain control processing for a regenerative signal given from an optical pickup by digital one. Since it is possible to use a conventional offset processing circuit and a gain control processing circuit by an analog about the preceding paragraph of an A/D converter, application to an existing product becomes easy. When giving a control value by a digital signal to an offset processing circuit and a gain control processing circuit, it becomes unnecessary to provide a DA translation.
0023
Mode for carrying out the invention Hereafter, an embodiment of an optical disk unit using a PRML regenerative-signal processing unit applied to this invention using Drawings is described in detail. A block diagram showing a 1st embodiment of a PRML regenerative-signal processing unit which requires drawing 1 for this invention, A block diagram showing a pattern detector with which drawing 2 is used for a PRML regenerative-signal processing unit, a block diagram in which drawing 3 shows an equalization-modulus controller, a block diagram in which drawing 4 shows a reference level controller, a block diagram in which drawing 5 shows offset controllers, and drawing 6 are the block diagrams showing a gain control machine.
0024< a 1st embodiment thru/or, a 6th embodiment : repetitive pattern discernment > a 1st embodiment, It is a PRML regenerative-signal processing unit which prevents degradation of the identification performance of data with identifying the VFO section in an optical disc and holding processing of the processing circuit of a regenerative signal suitably by detecting a repetitive pattern according to this in a regenerative signal.
0025 The PRML regenerative-signal processing unit 1 as a 1st embodiment concerning this invention shown in drawing 1 is provided with the following.
The optical pickup 11 provided near the optical disc D.
The preamplifier 12 which amplifies suitably the regenerative signal given from here.
AD converter 13 which changes into a digital signal the regenerative signal which is an analog signal from the preamplifier 12.
It is connected to AGC15 and this which are performed and AFC14 which comprises a digital circuit which receives the digitized regenerative signal which is supplied from AD converter 13, and performs offset processing, and the gain control which is similarly connected to this and comprises a digital circuit the equalization processing of a regenerative signal. It has the adaptive equalizer 16 constituted as a digital circuit to perform, and the adaptive Viterbi decoder 17 formed as an example of the decoder of a PRML system as the latter part of this. the ideal signal creation circuit 18 which receives the regenerative signal from the adaptive Viterbi decoder 17, and creates an ideal signal further -- and, Although it has the error signal calculation machine 19 which receives the ideal signal and the regenerative signal from the adaptive equalizer 16 which were received from the ideal signal creation circuit 8 and an ideal signal and an error signal are supplied to AFC14, AGC15, the adaptive equalizer 16, and the adaptive Viterbi decoder 17, respectively, Even

if all are not necessarily supplied, each control can be carried out to stability in the range supplied, and degradation of identification performance can be controlled. A stop signal also from the repetitive pattern detector 20 which received the regenerative signal from the adaptive Viterbi decoder 17, respectively, AFC14, AGC15, the adaptive equalizer 16, and the adaptive Viterbi decoder 17 are supplied, each control is similarly carried out to stability in the range supplied, and degradation of identification performance is controlled.

0026AFC14 has the offset controllers 22 and the comparator 21 further, AGC15 has the gain control machine 24 and the amplifier 23, the adaptive equalizer 16 has the equalization-modulus controller 26 and the equalizer 25, and the adaptive Viterbi decoder 17 has the reference level controller 28 and the Viterbi decoder 27, respectively.

0027 Operation of the PRML regenerative-signal processing unit 1 by such composition is explained in detail below. That is, information is recorded on the optical disc using the RLL code of d= 1. 4T repetition signal is recorded as VFO. The information recorded on the optical disc is played as a weak analog signal using PUH11. After an analog signal is amplified by the preamplifier 12 and serves as sufficient signal level, it is changed into a digital signal by AD converter 13. As for a digital signal, gain control and the 1st-step offset control are performed by AGC14. Then, 2nd offset control mentioned later is performed. Equalization of the regenerative signal by which offset control was carried out is carried out so that PR (1, 2, 2, 1) characteristic may be filled with the adaptive equalizer 16. From an equalization signal, it is decrypted by the Viterbi decoder 17 to binary decode data.

0028 Next, based on the decode data which is a regenerative signal, an ideal signal is computed by the ideal signal creation circuit 18, and an error signal is computed from an ideal signal and an equalization signal with the error signal calculation machine 19. In the equalization-modulus controller 26, an equalization modulus is computed in response to an error signal and a regenerative signal. In the reference level controller 28, reference level is computed in response to an error signal and an ideal signal. Similarly, in the offset controllers 22, an offset amount is computed in response to an error signal and an ideal signal.

0029 The decode data from the Viterbi decoder 17 is sent also to the repetitive pattern detector 20, and in the repetitive pattern detector 20, when decode data is 4T repetition pattern, a stop signal is outputted. In the equalization-modulus controller 26 mentioned above, the reference level controller 28, the offset controllers 22, and AGC15, while the stop signal is outputted from the repetitive pattern detector 20, adaptive control is suspended, and the last value is held. During 4T repetition pattern reproduction, even when regenerative-signal envelopes differ by the VFO section and a data division by suspending various adaptive control, the phenomenon in which a gain shifts at the data division head as shown by drawing 25 can be avoided. Even when the VFO section differs in the regenerative-signal characteristic from a data division, it becomes possible to control the increase in the convergence time of an equalization modulus, reference level, and an offset amount, and emission.

0030 Next, an example of the composition of a repetitive pattern detector is shown in drawing 2. In drawing 2, decode data is delayed by the 8xn unit delay elements 31 one by one, and n data for every 8 bits is calculated by AND circuit 32 and OR circuit 33. If the output of the NXOR circuits 34 and 35 is calculated per OR result with an AND result and all of n data are in agreement, a NXOR result will be set to 1 and will be set to 0 except it. By the calculation result of an AND circuit, an AND result is outputted as a stop signal per NXOR output of eight pieces.

0031 In the repetitive pattern detector 20, when n or more patterns of eight bit periods are recorded continuously, "1" is outputted as a stop signal, and when other, "0" is outputted. If a value of n is small, it will react also to a repetitive pattern which comes out in a data division by chance. On the contrary, in spite of being the VFO section when a value of n is large, and an error occurs in the VFO section, various adaptive control will resume operation. If these are taken into consideration, 4<=n<=32 can say that it is a suitable value.

0032 Next, an example of composition of an equalization-modulus controller is shown in drawing 3. Although a fundamental function has the portion which was common in a thing of drawing 20, it differs in that "0" is changed to an error signal by a stop signal. That is, the equalization-modulus controller 26 is provided with the following.

The switch element 36 which controls switching of an error signal by a stop signal.

Two or more delay devices 37 and 38 delayed in a regenerative signal.

The operator 39, the accumulation machine 40, and two or more comparators 41 and storage cells 42 of two or more.

0033 In such composition, when a stop signal is "0", it is connected to the error signal side and the switch element 36 operates as a usual adaptive equalization machine. On the other hand, when a stop signal is "1", the switch element 36 is connected to the earth side, and an equalization modulus is held, for example, stability of operation is obtained also in the VFO section.
0034 Next, an example of the composition of a reference level controller is shown in drawing 4. The reference level controller 28 is provided with the following.
The switch element 45 which switches an error signal with a stop signal.
The switch elements 46 and 47 which switch power supply potential with an ideal signal.
Two or more counters 48 and accumulation machines 49 which are connected to this, respectively.
Two or more switch elements 50 connected to these, respectively, two or more amplifiers 51 connected to these, two or more comparators 52 connected to these, and two or more storage cells 53 connected to parallel at these, respectively.

0035 The reference level controller 28 with such composition operates as follows. First, operation in case a stop signal is 0 is described. Corresponding to the level of an ideal signal, a switch can distribute an error signal, and it is respectively inputted into the accumulation machine 49. At this time, the number of times of occurrence of each level is simultaneously counted at the counter 48. For every predetermined time, division of the accumulation result is done by the number of times of occurrence for every level, and update values are calculated by carrying out the multiplication of the control sensitivity beta (0< beta<=1) to a divided result. By adding update values to the last reference level, reference level is computed newly. However, the initial values of reference level are 0, 1, 2, 3, 4, 5, and 6 respectively, and, as for the power up, these values are stored in the memory 53. When updating reference level, the counter 48 and the accumulation machine 49 are reset. When a stop signal is "1", "0" is chosen by the switch element 45 instead of an error signal. As a result, the value of an accumulation machine is set to "0", reference level will be held, and stability of operation is obtained also, for example in the VFO section.
0036 Next, an example of the composition of offset controllers is shown in drawing 5. The offset controllers 22 are provided with the following.
The switch element 57 which switches an error signal with a stop signal.
The switch element 58 by which the switching is controlled by the output of the center level detector 55 which received the ideal signal.
The accumulation machine 59 connected to the output of this.
It has the counter 56 which undergoes the output of the center level detector 55, the switch element 60 which switches the output of the accumulation machine 59 with the output of the counter 56, and the amplifier 61 which amplifies this output and also the comparator 62 by which multiple connection was carried out to the memory 63.
0037 Operation of the offset controllers 22 with such composition is explained. First, operation in case a stop signal is 0 is described. An error signal is sent to the accumulation machine 59, only when an ideal signal is the center level 3, i.e., a level. At this time, the number of times of occurrence of a center level is carried out count 56 simultaneously. For every predetermined time, division of the accumulation value is done by the number of times of occurrence, and update values are calculated by carrying out the multiplication of the control sensitivity gamma (0< gamma<=1) to a divided result. By adding update values to the last offset value, an offset value is computed newly. However, the initial value of an offset value is "0" and, as for the power up, "0" is stored in the memory. When updating an offset value, the value of the counter 56 and the accumulation machine 59 is reset. When a stop signal is "1", "0" is chosen by the switch element 57 instead of an error signal. as a result, an accumulation value is set to "0" and an offset value is held -- things -- a sake -- for example, the VFO section -- also setting -- stability of operation -- obtaining -- having .
0038 It becomes possible to be able to compute the optimal offset amount and to control degradation of identification performance as a result by it by this, even when asymmetry is contained in the regenerative signal by use of the offset controllers of drawing 5.
0039 As mentioned above, the offset controllers 22 of drawing 5 are the same as the portion

corresponding to the level 3 of the reference level controller 28 of drawing 4 except for a renewal period, updating sensitivity, and an initial value so that clearly from drawing 4 and comparison of 5. When the renewal period of the offset controllers 22 and the reference level controller 28 is the same, some reference level controllers 28 can be shared as the offset controllers 22.

0040 An example of the composition of an AGC circuit is shown in drawing 6. That is, AGC circuit 24 of drawing 6 is provided with the following.

The switch element 74 which switches an error signal with a stop signal.

The switch element 75 which switches with the output of the minimum level detector 72 which receives an ideal signal.

The accumulation machine 76 which undergoes this output.

It has the switch element 77 which switches the accumulation machine 76 with the output of the counter 73 and counter which undergo the output of the minimum level detector 72.

0041 Similarly, it has the switch element 68 which switches an error signal with a stop signal, the switch element 69 which switches with the output of the maximum level detector 66 which receives an ideal signal, and the accumulation machine 70 which undergoes this output. It has the switch element 71 which switches the accumulation machine 70 with the output of the counter 67 and counter which undergo the output of the maximum level detector 66.

0042 It has the comparator 78 which measures an output of these two switch elements 71 and 77, the amplifier 79 which amplifies this output, and the comparator 81 which measures that output and an output of the amplifier 80 which went via the memory 82, and this output is supplied as a gain.

0043AGC circuit 24 which has such composition operates as follows. That is, when a stop signal is "0", from a regenerative signal, an offset value and signal amplitude are calculated and offset control and a gain adjustment are performed using these values. When a stop signal is "1", an offset value and signal amplitude are held and offset control and a gain adjustment are performed with a held value. Thereby, stability of operation is obtained also, for example in the VFO section.

0044 As explained above, in a PRML regenerative-signal processing unit concerning this invention. During repetitive pattern reproduction, by holding an equalization modulus, reference level, an offset level, and a gain level, each control can be carried out to stability and degradation of identification performance can be controlled by detecting a repetitive pattern from decode data.

0045 In a PRML regenerative-signal processing unit concerning this invention, an offset amount of a center level can be computed using decode data and an equalization signal, and degradation of identification performance can be controlled by carrying out offset control of a regenerative signal using a computed offset amount.

0046 According to the embodiment mentioned above, although the cycle of the repetitive pattern was 8 bits, it is applicable to other repeating cycles.

0047 In the embodiment mentioned above, although equalization-modulus control, reference level control, offset control, and gain control were performed, it is also possible to use it, as it is not necessary to perform all simultaneously and only these parts were mentioned above.

0048 In the embodiment mentioned above, although the example of PR (1, 2, 2, 1) characteristic and the RLL code of d= 1 was shown, even when other PR characteristics and an RLL code are used, this invention can be applied and can demonstrate the same operation effect.

0049A 2nd embodiment is a PRML regenerative-signal processing unit supplying the stop signal from a repetitive pattern detector only to an adaptive equalizer. Drawing 7 is a block diagram showing a 2nd embodiment of the PRML regenerative-signal processing unit concerning this invention. In drawing 7, unlike the PRML regenerative-signal processing unit of drawing 1, instead of the adaptive Viterbi decoder, the fixed Viterbi decoder 102 which receives neither an ideal signal nor an error signal nor the stop signal from the repetitive pattern detector 20 from the exterior is used, and the given constant performs decoding processing. AFC and AGC which are given as a digital circuit in the case of drawing 1 are provided as analog AFC106 and analog AGC107, and other composition is common.

0050 In such composition, the adaptive equalizer 16 is receiving the stop signal from the repetitive pattern detector 20 in processing in the VFO section, when a stop signal is "0", it is connected to the error signal side and the switch element 36 of drawing 3 operates as a usual adaptive equalization machine. It is that the switch element 36 is connected to the earth side, and an equalization modulus is held on the other hand when a stop signal is "1", and it is possible to

obtain stability of operation also, for example in the VFO section. Thus, work of the repetitive pattern detector and stop signal concerning this invention does not necessarily need to be supplied to two or more treating parts, and even if it works on only the adaptive equalizer 16, it has a operation effect in the range.
0051A 3rd embodiment is a PRML regenerative-signal processing unit supplying the stop signal from a repetitive pattern detector to an adaptive equalizer and an adaptive Viterbi decoder. Drawing 8 is a block diagram showing a 3rd embodiment of the PRML regenerative-signal processing unit concerning this invention. AFC and AGC to which the PRML regenerative-signal processing unit which drawing 8 shows is given as a digital circuit by drawing 1 unlike the thing of drawing 1 are provided as analog AFC106 and analog AGC107, and other composition is common.
0052 Also in such composition, according to the stop signal from the repetitive pattern detector concerning this invention, when a stop signal is "1", about an adaptive equalizer and an adaptive Viterbi decoder, It becomes possible to obtain stability of operation also, for example in the VFO section with an equalization modulus and reference level being held, respectively.
0053 It is a PRML regenerative-signal processing unit, wherein a 4th embodiment supplied the stop signal from a repetitive pattern detector only to AFC14 and AGC15 and uses an equalizer and the Viterbi decoder as a cover half, respectively. Drawing 9 is a block diagram showing a 4th embodiment of the PRML regenerative-signal processing unit concerning this invention. Instead of the equalizer and the Viterbi decoder with which the PRML regenerative-signal processing unit which drawing 9 shows was given as adaptive by drawing 1 unlike the thing of drawing 1, the cover-half equalizer 101 and the cover-half Viterbi decoder 102 are formed, and other composition is common.
0054 Also in such composition, according to the stop signal from the repetitive pattern detector concerning this invention, when a stop signal is "0", an offset value and signal amplitude are calculated from a regenerative signal, and offset control and a gain adjustment are performed using these values. When a stop signal is "1", an offset value and signal amplitude are held and offset control and a gain adjustment are performed with the held value. This becomes possible to obtain stability of operation also, for example in the VFO section.
0055 It is a PRML regenerative-signal processing unit, wherein a 5th embodiment supplied the stop signal from a repetitive pattern detector to AFC14, AGC15, and an adaptive equalizer and uses the Viterbi decoder as a cover half. Drawing 10 is a block diagram showing a 5th embodiment of the PRML regenerative-signal processing unit concerning this invention. Instead of the Viterbi decoder with which the PRML regenerative-signal processing unit which drawing 10 shows was given as adaptive by drawing 1 unlike the thing of drawing 1, the cover-half Viterbi decoder is formed and other composition is common.
0056 Also in such composition, it is common in a 1st embodiment, and about the processing circuit where the stop signal was given, suitably, a control value is held and performs offset control, a gain adjustment, and equalization processing with the held value. This becomes possible to obtain stability of operation also, for example in the VFO section.
0057 Although a 6th embodiment is the PRML regenerative-signal processing unit which supplied the stop signal from a repetitive pattern detector to AFC14, AGC15, the adaptive equalizer, and the adaptive Viterbi decoder like a 1st embodiment, It is characterized by providing analog AFC and analog AGC in the preceding paragraph of a digital circuit region.
0058 Drawing 11 is a block diagram showing a 6th embodiment of the PRML regenerative-signal processing unit concerning this invention. The PRML regenerative-signal processing unit which drawing 11 shows differs from the thing of drawing 1, In the digital circuit region which comprises LSI of a digital circuit, etc., this case. It becomes the feature to have provided analog AFC106 and analog AGC107 into the analog circuit region usually established in the preceding paragraph of the field formed as one as circuits, such as LSI of analog circuitry, in the digital circuit after AFC14. That is, even if constituted combining analog LSI conventionally designed as elegance, and digital LSI which has the feature of new this invention, in order not to interfere on operation, a possibility that such composition will appear is high.
0059 Also in such composition, this invention can demonstrate a operation effect equivalent to a 1st embodiment, and the PRML regenerative-signal processing unit which can obtain stability of operation also in the VFO section of an optical disc can be provided.
0060 It is preferred to have the following specifications about the composition of drawing 15 which

drawing 11 which combined the conventional offset controllers and gain control machine in this case, and the offset controllers and the gain control machine of this invention constitutes and also mentions later, drawing 16, and drawing 17.
0061 That is, the reliability of identification data improves by changing the control band of the offset controllers which are the conventional analog circuitry, the offset controllers which are the digital circuits of this invention and the gain control machine which is the conventional analog circuitry, and the gain control machine which is the digital circuits of this invention. When the control band of the conventional offset controllers and a gain control machine is respectively set to BWafc1 and BWagc1 and the control band of the offset controllers of this invention and a gain control machine is specifically respectively set to BWafc2 and BWagc2, It is determined that it is set to 2<BWafc2/BWafc1<10002<BWagc2/BWagc1<1000 by the control band. Thereby, it becomes possible to raise the reliability of identification data.
0062< a 7th embodiment thru/or, a 12th embodiment: Digital AFC-AGC> a 7th embodiment is a PRML regenerative-signal processing unit using AFC and AGC which comprised a digital circuit concerning this invention. The repetitive pattern detector made indispensable at a 1st embodiment is not used for the embodiment after a 7th embodiment.
0063digital one which drawing 12 requires for this invention -- it is a block diagram showing a 7th embodiment of the PRML regenerative-signal processing unit using AFC and AGC. In drawing 12, although drawing 9 in which a 4th embodiment was shown, and fundamental composition are common, it is making not to form the repetitive pattern detector 20 into the point of difference.
0064digital one which starts this invention by such composition -- the following operation effects are demonstrated by providing AFC and AGC. That is, since the ideal signal from the ideal signal creation circuit 18 and the error signal from the error signal calculation machine 19 are given as a control signal of a digital signal, in AFC and AGC as conventional analog circuitry, the necessity for a required DA translation of them is lost. Compared with AFC and AGC by analog circuitry, high speed processing is further made possible by being referred to as AFC and AGC by a digital circuit. moreover -- further -- digital one of this invention -- it also becomes a thing of the type with which AFC and AGC as analog circuitry exist in the A/D converter preceding paragraph applicable also when newly introducing AFC and AGC into the conventional system.
0065 Thereby, AFC14 follows a main change of the regenerative signal from an optical disc, and it carries out variable control of the offset amount so that the DC component of an output signal may become zero. AGC15 follows the amplitude fluctuation to which the regenerative signal from an optical disc is changed every moment, and it carries out variable control of the amplification factor so that the amplitude of an output signal may become fixed.
0066 An 8th embodiment is a PRML regenerative-signal processing unit using AFC and AGC which comprised a digital circuit similarly, and takes the form which adds the error signal from an error signal calculation machine to AFC and AGC, and is supplied also to the adaptive equalizer 16. Drawing 13 shows this and shows the structure where the error signal from an error signal calculation machine is supplied also to the adaptive equalizer 16. Also in this composition, the same operation effect as a 7th embodiment is shown.
0067A 9th embodiment is a PRML regenerative-signal processing unit using AFC and AGC which comprised a digital circuit similarly, and takes the form which adds the error signal from an error signal calculation machine to AFC and AGC, and is supplied also to the adaptive equalizer 16 and the adaptive Viterbi decoder 17. Drawing 14 shows this and the structure where the error signal from an error signal calculation machine is supplied also to the adaptive equalizer 16 and the adaptive Viterbi decoder 17 is shown, Also in this composition, like a 7th embodiment and an 8th embodiment, a DA converter is made unnecessary and high speed processing is made possible compared with AFC and AGC of analog circuitry.
0068a 10th embodiment -- a 7th embodiment -- in addition, the former using analog AFC and analog AGC of the conventional type -- elegance -- digital one of this invention -- the form to which AFC and AGC were made to apply is shown. Also in this composition shown in drawing 15, like a 7th embodiment etc., a DA converter is made unnecessary and high speed processing is made possible compared with AFC and AGC of analog circuitry.
0069an 11th embodiment -- an 8th embodiment -- in addition, the former using analog AFC and analog AGC of the conventional type -- elegance -- digital one of this invention -- the form to which AFC and AGC were made to apply is shown. Also in this composition shown in drawing 16, like a

7th embodiment etc., a DA converter is made unnecessary and high speed processing is made possible compared with AFC and AGC of analog circuitry.
0070a 12th embodiment -- a 9th embodiment -- in addition, the former using analog AFC and analog AGC of the conventional type -- elegance -- digital one of this invention -- the form to which AFC and AGC were made to apply is shown. Also in this composition shown in drawing 17, like a 7th embodiment etc., a DA converter is made unnecessary and high speed processing is made possible compared with AFC and AGC of analog circuitry.
0071 By as mentioned above, the thing for which AFC and AGC which comprised a digital circuit concerning this invention are used about a 7th embodiment thru/or a 12th embodiment. Application to LSI of AFC and AGC of the analog circuitry of elegance, etc. is conventionally made easy, and the PRML regenerative-signal processing unit which realizes high speed processing, and the optical disk unit using this can be provided, enabling supply to each processing circuit of a digital control signal without using a DA converter.
0072<Optical disk unit with which PRML regenerative-signal processing unit of this invention is applied> (basic constitution) drawing 18 is a figure showing the composition of the whole optical disk unit with which the PRML regenerative-signal processing unit concerning this invention is applied. In this figure, optical disk unit A performs Data Recording Sub-Division or data reproduction to optical disc D. The above-mentioned optical disk unit A is provided with the following.
The tray 132 which conveys optical disc D stored by the disk cartridge.
The motor 33 which drives this tray.
The clamping circuit 134 holding optical disc D.
The spindle motor 135 made to rotate optical disc D held by this with a prescribed rotational frequency.
CPU146 which performs the whole motion control as a control section, ROM147 which store the fundamental program of this control action, etc., and RAM148 which store each control program, application data, etc. so that rewriting is possible are connected via the control bus. The feed motor 136 which is connected to the control section of these CPU146 grades, respectively, and conveys the pickup PU, The focus and tracking control of a pickup. The focus / tracking actuator driver / delivery Motor Driver 140 to perform and also the spindle motor driver 141 which drives the spindle motor 135, and tray Motor Driver 142 which drives a tray motor are formed, respectively.
0073RAM143 for storing the data processing unit 3 for processing the preamplifier 12 which is connected to the pickup PU and amplifies a detecting signal further, the pickup PU and the preamplifier 12, a detecting signal, and a record signal, and the data used for this various processing is provided. The interface control 145 is formed with RAM144 in order to transmit and receive the signal from this data processing unit 3 between external devices.
0074 In such an optical disk unit, in the data processing unit 3 as shown in drawing 18 by this invention, With constituting including AFC14, such as drawing 1 mentioned above, AGC15, the adaptive equalizer 16, the adaptive Viterbi decoder 17, the ideal signal creation circuit 18, the error signal calculation machine 19, and repetitive pattern detector 20 grade. The optical disk unit which realizes a 1st embodiment thru/or a 12th embodiment mentioned above, respectively is made possible.
0075(Processing operation) An optical disk unit formed in enforcement of this invention which has such composition performs regeneration and recording processing of an optical disc as follows. Namely, if optical disk unit A is loaded with optical disc D, the pickup PU and the data processing unit 3 will be used, Control information on optical disc D currently recorded on a control data zone in an embossing data zone of read in area of optical disc D is read, and CPU146 is supplied.
0076 In the bottom of control of CPU146 based on control information on optical disc D currently recorded on a control data zone in operation information by a user's operation, or an optical disc in optical disk unit **of this invention** A, the present status, etc., It is energized with a laser control unit which is not illustrated, and a laser beam is generated.
0077 It converges with the object lens 131 and a generated laser beam is irradiated to a record section of a disk. Thereby, data is recorded on a storage area of optical disc D (generation of mark rows: with a variable-length mark and an interval of a mark.). Or data is recorded on optical disc D by the length of each variable-length mark, a reflected wave corresponding to data stored is

reflected, this is detected, and playback of this data is performed.

0078 This optical disc D is stored by direct or the disk cartridge, and is conveyed in equipment on the tray 132 so that optical disc D may counter the object lens 131 and may be arranged. The tray motor 133 for driving this tray 132 is formed in equipment. Optical disc D with which it was loaded is held by the clamping circuit 134 on the spindle motor 135 pivotable, and rotates to a prescribed rotational frequency with this spindle motor 135.

0079 The pickup PU has a photodetector (not shown) which detects a laser beam to the inside of it. This photodetector detects the laser beam which was reflected by optical disc D and returned via the object lens 131. The detecting signal (current signal) from a photodetector is changed into a voltage signal with current/voltage converter (I/V), and this signal is supplied to the preamplifier 12 and the servo amplifier 134. From the preamplifier 12, the signal for reproduction of the object for reproduction of the data of a header unit and the data of a record section is outputted to the data processing unit 3.

0080 Here, methods of detecting the amount of focal gaps optically include the following astigmatic method and the knife-edge method, for example. It is the method of detecting the shape change of the laser beam which arranges the optical element (not shown) which makes the detecting optical path of a laser beam reflected with astigmatic method, i.e., the light reflection film layer of optical disc D, or light reflex nature record film generating astigmatism, and is irradiated on a photodetector. The photodetection field is quadrisected in the shape of a diagonal line. The difference of diagonal Hotan is taken within the servo seek control unit which is not illustrated to the detecting signal acquired from each detection area, and a focus-error-detection signal (focusing signal) is acquired. It is the knife-edge method, i.e., the method of arranging knife edge which shades a part asymmetrically to the laser beam reflected by optical disc D. A photodetection field is divided into two, takes the difference between the detecting signals acquired from each detection area, and acquires a focus-error-detection signal. Usually, either the above-mentioned astigmatic method or the knife-edge method is adopted.

0081 Optical disc D has a track of spiral shape or concentric circle shape, and information is recorded on a track. Condensing spot is made to trace along this track, and reproduction of information, or record/elimination is performed. In order to be stabilized and to make condensing spot trace along a track, it is necessary to detect a relative location gap of a track and condensing spot optically.

0082 Generally as a track-deviation detecting method, at least that of the following has phase reference detection system, the push pull method, the twin spotting method, etc. The intensity distribution change on the photodetector of the laser beam reflected with a phase-difference-detection (Differential Phase Detection) method, i.e., the light reflection film layer of optical disc D, or light reflex nature record film is detected. The photodetection field is quadrisected on the diagonal line. To the detecting signal acquired from each detection area, the phase contrast of diagonal Hotan is taken within the servo seek control unit 39, and a track error detecting signal (tracking signal) is acquired. In the push pull (Push-Pull) method, i.e., this method, the intensity distribution change on the photodetector of the laser beam reflected by optical disc D is detected. A photodetection field is divided into two, takes the difference between the detecting signals acquired from each detection area, and acquires a track error detecting signal. A diffraction element etc. are arranged in the light transmission system between the twin spotting (Twin-Spot) methods, i.e., a semiconductor laser element and the optical disc D, wavefront splitting of the light is carried out to plurality, and reflected-light-quantity change of the primary ** diffracted light with which it irradiates on optical disc D is detected. The photodetection field which detects the reflected light quantity of the primary + diffracted light and the reflected light quantity of -primary diffracted light separately apart from the photodetection field for regenerative-signal detection is arranged, the difference of each detecting signal is taken, and a track error detecting signal is acquired.

0083 From the servo seek control unit which is not illustrated by such focus control and track control to a focusing signal. A tracking signal and a delivery signal send to a focus and a tracking actuator driver row, and are sent to Motor Driver 140, focus servo control of the object lens 131 is carried out by this driver 140, and tracking servo control is carried out. According to an access signal, an energization signal is supplied to the feed motor 136 from the driver 140, and the transfer control of the pickup PU is carried out.

0084 The spindle motor driver 141 and tray Motor Driver 142 are controlled by the control signal

from the data processing unit 3, The spindle motor 135 and the tray motor 133 will be energized, the spindle motor 135 will rotate with a prescribed rotational frequency, and the tray motor 133 will control a tray appropriately.

0085 The regenerative signal S corresponding to the data of the header unit supplied to the data processing unit 3 is supplied to CPU146. Thereby, CPU146 judges the sector number as an address of a header unit with the regenerative signal S, and performs comparison with the sector number as an address (the data which records data or is recorded is reproduced) to access.

0086 The regenerative signal S corresponding to the data of the record section supplied to the data processing unit 3. Data required for RAM148 is stored, the regenerative signal S is processed with this data processing unit 3, and the interface control 145 is supplied, for example, a regeneration signal is supplied to external devices, such as a personal computer.

0087 In such optical disk unit A, the characterizing portion of the PRML regenerative-signal processing unit concerning a 1st embodiment thru/or a 12th embodiment of this invention mentioned above is mainly given as composition of the data processing unit 3, and the operation effect mentioned above is demonstrated.

0088 That is, in a 1st embodiment thru/or a 6th embodiment, the VFO section of an optical disc can mainly be detected using the repetitive pattern detector 20, and degradation of identification performance can be controlled by carrying out hold processing of the control value of each control section only in the meantime. Furthermore, in a 7th embodiment thru/or a 12th embodiment, it is mainly providing AFC and AGC as a digital circuit, and the optical disk unit which realizes high-speed control management is provided, making a DA converter etc. unnecessary.

0089 By each embodiment explained in full detail above, the person skilled in the art can realize this invention. However, it is possible to apply the principle in the large meaning in which various modifications of these embodiments are in ** easily, and were indicated by the person skilled in the art to various embodiments, even if it does not have invention capability. Thus, it cannot be overemphasized that it is not what is limited to the embodiment which this invention attains to the extensive range which is not contradictory to the indicated principle with the new feature, and was mentioned above.

Brief Description of the Drawings

Drawing 1 The block diagram showing a 1st embodiment of the PRML regenerative-signal processing unit concerning this invention.

Drawing 2 The block diagram showing the repetitive pattern detector of the PRML regenerative-signal processing unit concerning this invention.

Drawing 3 The block diagram showing the equalization-modulus controller of the PRML regenerative-signal processing unit concerning this invention.

Drawing 4 The block diagram showing the reference level controller of the PRML regenerative-signal processing unit concerning this invention.

Drawing 5 The block diagram showing the offset controllers of the PRML regenerative-signal processing unit concerning this invention.

Drawing 6 The block diagram showing the gain control machine of the PRML regenerative-signal processing unit concerning this invention.

Drawing 7 The block diagram showing a 2nd embodiment of the PRML regenerative-signal processing unit concerning this invention.

Drawing 8 The block diagram showing a 3rd embodiment of the PRML regenerative-signal processing unit concerning this invention.

Drawing 9 The block diagram showing a 4th embodiment of the PRML regenerative-signal processing unit concerning this invention.

Drawing 10 The block diagram showing a 5th embodiment of the PRML regenerative-signal processing unit concerning this invention.

Drawing 11 The block diagram showing a 6th embodiment of the PRML regenerative-signal processing unit concerning this invention.

Drawing 12digital one concerning this invention -- the block diagram showing a 7th embodiment of the PRML regenerative-signal processing unit using AFC and AGC.

Drawing 13digital one concerning this invention -- the block diagram showing an 8th embodiment of the PRML regenerative-signal processing unit using AFC and AGC.
Drawing 14digital one concerning this invention -- the block diagram showing a 9th embodiment of the PRML regenerative-signal processing unit using AFC and AGC.
Drawing 15digital one concerning this invention -- the block diagram showing a 10th embodiment of the PRML regenerative-signal processing unit using AFC and AGC.
Drawing 16digital one concerning this invention -- the block diagram showing an 11th embodiment of the PRML regenerative-signal processing unit using AFC and AGC.
Drawing 17digital one concerning this invention -- the block diagram showing a 12th embodiment of the PRML regenerative-signal processing unit using AFC and AGC.
Drawing 18 The block diagram showing one embodiment of the optical disk unit using the PRML regenerative-signal processing concerning this invention.
Drawing 19 The block diagram showing the conventional PRML regenerative-signal processing unit.
Drawing 20 The block diagram showing the conventional adaptive equalizer.
Drawing 21 The block diagram showing the reference level controller of the conventional adaptive Viterbi decoder.
Drawing 22 The graph which shows the waveform of a PRML regenerative-signal processing unit of operation.
Drawing 23 The graph which shows the equalization signal, ideal signal, and error signal concerning PRML regenerative-signal processing.
Drawing 24 The graph which shows the regenerative-signal envelope containing a repetitive pattern and random data.
Drawing 25 The graph which shows the regenerative-signal envelope and error signal RMS value after the conventional offset control and gain control.
Drawing 26 The graph which shows the regenerative signal containing the asymmetry after performing the conventional offset control and gain control.

Explanations of letters or numerals

14 -- AFC and 15 -- AGC and 16 -- Adaptive equalizer
17 -- An adaptive Viterbi decoder and 18 -- Ideal signal preparing part
19 -- An error signal calculation machine and 20 -- Repetitive pattern detector
101 -- A fixed equalizer and 102 -- Fixed Viterbi decoder
106 -- Analog AFC and 107 -- Analog AGC

Drawing 1

For drawings please refer to the original document.

Drawing 2

For drawings please refer to the original document.

Drawing 3

For drawings please refer to the original document.

Drawing 5

For drawings please refer to the original document.

Drawing 11

For drawings please refer to the original document.

Drawing 15

For drawings please refer to the original document.

Drawing 16

For drawings please refer to the original document.

Drawing 4

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Drawing 6

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Drawing 7

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Drawing 24

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Drawing 8

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Drawing 9

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Drawing 10

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Drawing 12

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Drawing 23

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Drawing 26

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Drawing 13

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Drawing 14

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Drawing 17

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Drawing 18

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Drawing 22

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Drawing 25

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